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NRC · CNRC

IRC research has implications for type and placement of smoke detectors in homes

Working with the Underwriters' Laboratories of Canada, researchers in IRC's Fire Risk Management Program have found that using ionization-photoelectric smoke detectors is more effective than using ionization or photoelectric detectors alone in homes. These findings are the result of a series of full-scale experiments in Kemano, a deserted company town built by Alcan Smelters and Chemicals Ltd. during the 1950s and donated to British Columbia's Office of the Fire Commissioner for training and research.

Two Kemano dwellings served as test sites for the experiments: a 900-square-foot one-storey house and a 1400-square-foot two-storey house. In both dwellings, the researchers installed groupings of three types of detectors—photoelectric, ionization and photoelectric-ionization combined—in code-required as well as several other locations.

The researchers recreated fire scenarios that often occur in homes, including both flaming and smouldering fires of wood, paper, polyurethane foam, cotton flannel, upholstered furniture and cooking oil. All fires started small and grew slowly to challenge the smoke detectors.

In general, the results of the experiments backed up expectations from previous experiments. Ionization-photoelectric combined detectors performed as well or better in each fire scenario than ionization detectors or photoelectric detectors alone. In addition, smoke detectors located in every room provided the best early warning of fires. Smoke detectors of any type outside the room of origin took significantly longer to detect fires if separated from the fire by a

Continued on page 5

A house is burned as part of a series of full-scale experiments in Kemano, BC.

An IRC staff member checks the experimental set-up for an investigation into the effectiveness of various types of smoke detectors.

Highlights

Proposed code changes
Canada-Russia housing
Ventilating tunnel fires
Water penetration in walls
New tools for roofing industry
Corrosion inhibitors in concrete
Environmental psychologists at IRC

2007-03608/

Proposed technical changes for the next edition of the National Building Code

Rapid technological advancements, coupled with regulatory, industry and stakeholder concerns, have prompted the standing committees responsible for three of the national model codes—the National Building Code (NBC), the National Fire Code (NFC) and the National Plumbing Code (NPC)—to recommend changes to these documents.

During the winter of 2002–2003, the Canadian Commission on Building and Fire Codes (CCBFC) and the provinces and territories will hold coordinated national public consultations on these proposed changes. This issue of *Construction Innovation* describes the more significant changes to the NBC, Parts 3 and 9. The previous issue addressed proposed changes to the NFC and the NPC.

Proposed changes to the NBC, Part 9, Housing and Small Buildings

Lateral load resistance

Many houses with traditional configurations have inherent lateral load resistance. However, larger houses with non-traditional configurations, such as open floor plans, and other non-residential buildings covered by Part 9 may not. Proposed changes define configurations and areas with high seismic and wind loads in which lateral load analysis will be required.

Protection from precipitation

There are a number of proposed new requirements for protection from precipitation ingress. These include:

- Simple prescriptive requirements to address junctions between walls and roofs or decks.
- A description of protection from precipitation as two planes of protection: the cladding and the sheathing membrane and flashing.
- A requirement for all residential buildings to be constructed with two planes of protection. In high moisture load regions, the two planes of protection would be required to be separated by a capillary break.
- Additional locations where flashing is needed, with specifications for minimum extensions, slope and end dams.

To determine high moisture load regions, a new single-number moisture index is proposed for Appendix C. Coastal areas would have higher moisture indices, while prairie areas would have lower.

Ventilation

Proposed changes to address industry difficulties in complying with the prescriptive mechanical ventilation requirements in Section 9.32. include:

- Both an adjustable damper and a mechanical damper in the outdoor air duct to a forced air heating system.
- If spillage-susceptible combustion equipment is present, make-up air fans of the same capacity should be linked to bathroom and kitchen exhaust fans. If not, an exhaust-only ventilation system is acceptable.

CSA standard CAN/CSA-F326, "Residential Mechanical Ventilation Systems," continues to be an alternative method for designing ventilation systems.

Carbon monoxide detectors

There is a proposed requirement for Part 9 calling for CO detectors in any dwelling that incorporates combustion equipment or an attached garage. A similar change is proposed to Part 6 of the NBC.

Other proposed changes

- All materials in components and assemblies regulated by Part 9 would be required to be compatible with adjoining materials and resistant to expected deterioration.
- Requirements for stairs, handrails and guards would be relaxed in a number of cases.
- All basements would be required to incorporate at least one window complying with the minimum dimension requirements of Article 9.7.1.3. for emergency egress, whether or not the basements have bedrooms.
- Loose-fill insulation would be permitted in basement walls.
- Virtually all post-disaster buildings would be excluded from Part 9. These are buildings essential to provide services in the event of a disaster.
- Spatial separation would be clarified.
- Provisions would be added for insulated concrete form (ICF) walls, reinforced masonry foundations and deck supports.
- Requirements for higher ceiling heights and windows in certain rooms would be eliminated, although most bedrooms would still be required to have a window for ventilation and emergency egress.

Proposed changes to the NBC, Part 3, Fire Protection, Occupant Safety and Accessibility

Firewalls

It is proposed that the requirement for two-hour firewalls of masonry or concrete construction be changed from a prescriptive requirement to a performance-based requirement. This proposal will allow other design alternatives to be used.

Protection of foamed plastic

It is proposed that the requirements addressing the fire protection of foamed plastics in buildings of combustible construction be modified to make the means of protection more specific. This emphasizes the need

to test the protective layers, but also allows for the possibility of using previously permitted protective materials.

Mezzanines
A number of changes have been proposed to address the concept of mezzanines. The changes address such issues as calculation of building area, fire-resistance rating, and exit travel distance while at the same time simplifying the application of this Subsection.

Voice communications
It has been proposed that a voice communication system be provided in certain mercantile occupancies, specifically "Big Box Stores." This new provision will address life-safety concerns raised as a result of several human behavior studies and past fire incidences in this type of store.

Special Changes to the NBC

In addition to the proposed technical changes described above, the Commission has previously issued special code changes without submitting them for public review (see www.ccbfc.org). This process is followed when, in the opinion of the Commission, a situation exists that is potentially dangerous or that restricts the appropriate use of materials, appliances, systems, equipment, methods of design, construction procedures, industrial processes, methods of operation, or storage facilities. CCBFC procedures require such Special Changes to be included in the next package of public comments.

Recent Special Changes include those related to:

Foamed plastic insulated panels
This change allows the use of factory-produced insulated panels for cold storage buildings, thus eliminating the economic burden placed on industry and designers to continue to request and support the acceptance of these panels.

Nonmetallic raceways
This change allows larger size nonmetallic conduit within a fire compartment. Being able to use nonconductive and relatively corrosion resistant raceways in industrial buildings and in service spaces provides a safety benefit for people working in close proximity to the raceways.

The changes described above are just some of the proposed modifications to the NBC. The complete list of changes will be available for viewing on the CCBFC Web site at www.ccbfc.org during the public consultation, which will be held in the winter of 2002–2003. Code users are strongly encouraged to view this list and submit comments.

Newsbrief

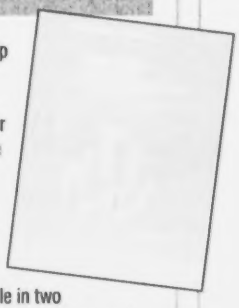
New construction codes Web site

Users of the national building, fire, plumbing and other model codes are advised that a new **national code documents** Web site, www.nationalcodes.ca, will be launched in September 2002, replacing the current Canadian Commission on Building and Fire Codes (CCBFC) site, www.CCBFC.org. The CCBFC's new site has features such as

- 'What's new' and FAQ sections for each code;
- the capability to allow code users to submit questions and request code changes on-line;
- a calendar with details of committee meetings and presentations;
- links to code documents, special changes, errata and revisions; and, in future,
- a database of proposed changes, including the status of each change.

To receive notification of the consultation, contact the Canadian Codes Centre at (613) 993-9960 or e-mail: codes@nrc.ca.

If you're in the business of designing or installing plumbing systems, then this new user's guide is for you!



The new *User's Guide – National Plumbing Code of Canada 1995* will help you apply the requirements of the National Plumbing Code (NPC) by explaining the intent of each requirement. This easy-to-read guide contains supporting additional information and over 100 diagrams for further clarification. Where applicable, excerpts from the National Building Code and other referenced documents have been included to provide users with a better understanding of the requirements of the NPC.

This Guide has been prepared to assist people involved in the design, modification or approval of plumbing systems. It will be particularly useful to those in apprenticeship programs for plumbers.

The *User's Guide – National Plumbing Code of Canada 1995* is available in two practical, portable formats: a soft-cover book and a Special Edition CD-ROM with improved search and print capabilities. The **soft-cover book** is available for **$47** and the **CD-ROM version**, for **$85**.

To order, please contact IRC's Publication Sales department:
Tel.: 1-613-993-2463 or 1 800 672-7990
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E-mail: IRC.Client-Services@nrc.ca

Several more successes for Canada-Russia housing project

IRC can now add several more achievements to an already impressive record of success with the Canada-Russia housing project, which is sponsored by the Canadian International Development Agency (CIDA) and managed by the Canada Mortgage and Housing Corporation (CMHC). Over the past year, IRC has hosted a group of Russian officials on another information-gathering mission; completed their work on Russian code development; and signed a letter of agreement with Russia to share information for the evaluation of Canadian products.

In November 2001, five Russian officials met with their counterparts at the Canadian Codes Centre. They were at IRC to review Russia's last questions on two final sets of housing regulations: those that applied to the mechanical and electrical systems of single-family dwelling units, and those that applied to the design and construction of energy-efficient wood-frame, single-family residential houses. These regulations built on the Russian Building Code for Single Family Housing, which IRC helped to develop, and were approved by the Russian Government in March 2001.

The successful outcome of the Russian group's visit set the stage for the Russian Federation State Committee on Construction and Housing (GOSSTROY of Russia) to ratify the regulations during the Team Canada mission to Russia in early 2002. Team Canada later heralded the passing of these regulations as a significant success because they will impact the entire Canadian construction industry rather than just a single company or business. One Canadian company, Nascor Incorporated, has already built two plants in Russia for manufacturing wood I-joists and I-studs used in the construction of energy-efficient housing.

For IRC, the completion of these last two regulations also marked a huge milestone. The multi-year project saw Canada's building codes and standards recognized for their excellence and used as a model in the development of building codes for another country.

"IRC experts have been very supportive from the beginning of the project," says CMHC Project Manager Angela Pavlova. "They provided the technical information and expert advice on critical issues that were needed. Before Russia was convinced that they should adapt Canada's building codes, Russians had the perception that wood-frame houses weren't sufficiently safe and fire resistant. Now, 'Canadian' homes are becoming more and more popular."

This popularity has created a demand for Canadian products and services in Russia. In August 2001, IRC's Canadian Construction Materials Centre (CCMC) signed a letter of agreement with the Russian Federation's Centre of Certification in Construction to share material from Canadian technical guides to be used as a basis for the evaluation of innovative products in Russia.

This agreement establishes a working relationship for product approval between Canada and Russia. It also builds on the joint declaration signed in 2000 to increase cooperation and help eliminate technical barriers to trade related to construction products and systems.

Because Russia was limited to brick, block and masonry construction in the past, the increasing popularity of wood-frame homes is creating a greater demand for Canadian construction products in Russia. With the letter of agreement in place, it will now be possible for Russia to get the construction products and services they need, while Canadian manufacturers will get easier access to this new market.

Specific questions can be directed to Mr. Luc Cécire, CCMC, at (613) 993-0776, fax (613) 952-0268, or e-mail luc.cecire@nrc.ca.

Registry of Product Evaluations

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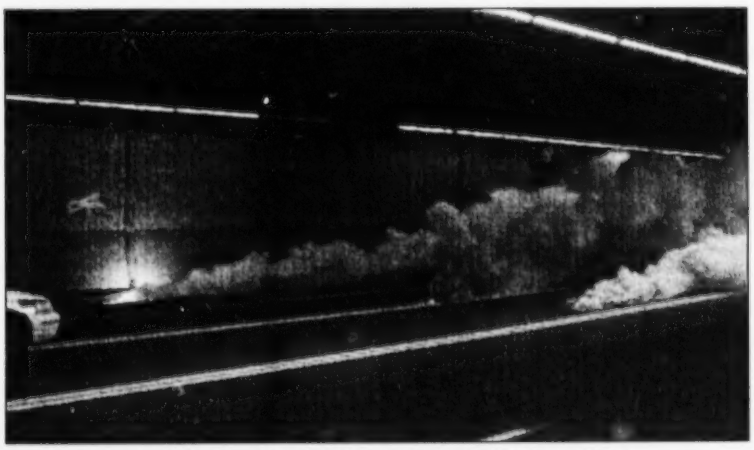
Project to validate emergency ventilation strategies for two tunnels in Montreal



Smoke moves through a Montreal tunnel in an MTQ study of ventilation strategies in emergencies.

How adequate are emergency ventilation strategies for passenger vehicle tunnels in the event of a stopped vehicle on fire in a tunnel? Researchers in IRC's Fire Risk Management Program are working with the Ministry of Transportation for Quebec (MTQ) to answer this question for the mechanical ventilation systems in two tunnels in Montreal.

Mechanical ventilation systems provide the temperature, humidity and air velocity conditions necessary to give tunnel users a reasonable degree of comfort during normal operation. When a fire occurs in a tunnel, the system must also provide a safe evacuation route for tunnel users and access for fire fighting services.

Using computational fluid dynamic based models developed specifically for tunnel emergency ventilation applications, IRC researchers are validating current emergency ventilation strategies for selected fire scenarios in the two tunnels. These models break the tunnels down into hundreds of thousands of brick-like cells, allowing the researchers to predict in great detail the temperature, air velocity and smoke concentration at various points in the tunnel. This detailed information, in turn, allows them to evaluate the effectiveness of the emergency strategy.

Over the next three years, IRC researchers will also verify the results of the computer modelling using full-scale testing. This information will aid in the development of emergency tunnel ventilation strategies using detection systems and automatic responses to replace some of the manually operated systems currently in use.

Specific questions can be directed to Dr. Ahmed Kashef at (613) 990-0646, fax (613) 954-0483, or e-mail ahmed.kashef@nrc.ca.

IRC research has implications for type and placement of smoke detectors in homes

Continued from cover page

closed door. If the doors were open, they detected the fires as quickly as the detectors inside the room.

Surprisingly, however, smoke detectors installed in the "dead air space" (the triangular area 10 cm from ceiling and wall joints in each direction) were among the first to detect fires. Theoretically, smoke detectors should not work in this space, and Canadian standards for the devices require that this space be avoided in installation. IRC researchers will pass this finding on to smoke detector manufacturers and associations. If there is interest from these groups, they will pursue further research in this area.

This project was part of an ongoing effort in the fire protection community to maximize the benefit of current smoke detector technologies to improve residential fire safety. Between 1985 and 1995, Canada's death rate in fires declined by more than 40 percent. Much of this decline is attributed to the use of residential smoke alarms and the enforcement of the relevant codes and standards.

Specific questions can be directed to Dr. Joseph Su at (613) 993-9616, fax (613) 954-0483, or e-mail joseph.su@nrc.ca.

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http://www.nrc.ca/irc/newsletter/toc.html

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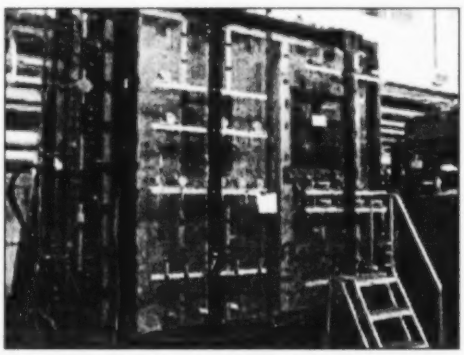
Results of IRC water penetration study will help industry tailor wall assemblies to climate

Major advances have recently been made in the industry's capability to evaluate wall assemblies against computer-modelled performance in a particular climate. When used in combination with IRC's hygrothermal modelling tool, hygIRC, the results of a major IRC laboratory study to assess water penetration in large-scale wood-frame wall assemblies become an effective new tool in determining whether walls may be vulnerable to premature deterioration. This capability was developed as part of IRC's Consortium for Moisture Management for Exterior Wall Systems (MEWS) project (see *Construction Innovation*, June 2002 for industry partners).



Wall specimen undergoing water penetration tests in IRC's Dynamic Wind and Wall Testing Facility

To arrive at these results, IRC researchers assessed the water penetration characteristics of 17 wall specimens that combined different types of cladding, sheathing membranes and boards, and insulation used in North American construction. Industry partners helped to select material combinations representative of current practice, as well as other materials of interest. Cladding types included stucco, brick veneer, hardboard and vinyl siding, and exterior insulation and finish systems (EIFS). Sheathing boards included glass mat gypsum board, oriented strand board (OSB), fibreboard and XPS foam sheathing.

In each wall specimen, the researchers included a window, a vent duct and an electrical outlet (see photo). At the preliminary stage of the water penetration tests, the researchers also included small deficiencies in the specimens, such as missing caulking around these openings that provided a water leakage path to the stud cavity in certain instances. In addition, they included small bins on the inside face of the sheathing board to collect water as it came through, pressure sensors to monitor air pressure differentials, and moisture sensors to determine when the sheathing board was getting wet.

By providing certain kinds of data to IRC's model, hygIRC, results from parametric studies can be used to assess whether wall systems are vulnerable to premature deterioration and which parts of walls are subject to the effects of moisture ingress.

IRC researchers then subjected each wall specimen to simulated wind-driven rain of various intensities in IRC's unique Dynamic Wind and Wall Testing Facility (DWTF). The facility comprises a water spray system that simulates the action of rain; a blower to simulate wind effects; and a piston, which through its in and out action, varies air pressure to simulate wind gusts.

The results of these tests provide information about the amount of water that leaks into the stud cavity when the walls are subjected to given wind pressures and spray rates. This information is a crucial element that links climate and the anticipated effects of wind-driven rain to the consequences of water ingress into the wall assembly. By providing water ingress, pressure and spray-rate data to IRC's 2-D hygrothermal model, hygIRC, results from parametric studies can be used to assess whether or not given wall systems are vulnerable to premature deterioration, as well as which parts of walls are possibly subject to the undesirable effects of moisture ingress.

IRC researchers are currently preparing several reports related to the MEWS project. One of these reports will concentrate on the laboratory investigation of rain penetration in the 17 large-scale wood-frame specimens. That report is expected to be made public in the fall of 2002.

For more information on the MEWS research project, visit the MEWS Web site at http://www.nrc.ca/irc/bes/mews. Specific questions about water penetration in wood-frame wall assemblies can be directed to Dr. Michael Lacasse at (613) 993-9715, fax (613) 954-5984, or e-mail michael.lacasse@nrc.ca.

SIGDERS research results in two new tools for better understanding of roofing performance

The roofing industry now has two new tools at their disposal to investigate their products more accurately: a method to test the resistance of mechanically attached flexible membrane roofing systems to dynamic wind uplift, and a facility to test roofing systems under simultaneous dynamic wind and temperature conditions. These tools result from the completion of Phase II of the IRC-led SIGDERS consortium research project. SIGDERS stands for the Special Interest Group for Dynamic Evaluation of Roofing Systems.

IRC researchers developed the standardized test method using extensive wind tunnel testing, computer modelling and IRC's Dynamic Roofing Facility (DRF), which was designed and built during the first phase of the SIGDERS project. This work resulted in a developed load cycle that, for the first time, allows manufacturers to test their products in conditions that:

- mimic real wind effects;
- achieve failure modes observed under real conditions;
- identify the weakest link in the roof design;
- are easier to apply in the laboratory than existing tests;
- produce results quickly;
- conform to local standards; and
- account for variation in the building's internal pressure.

The developed dynamic load cycle has eight loading sequences. These loading sequences are grouped into five levels, which start with the lower pressures and increase gradually with each level. The loading cycle has the capacity to test roof samples subjected to simulated gusts of twice the design pressure.

SIGDERS membership

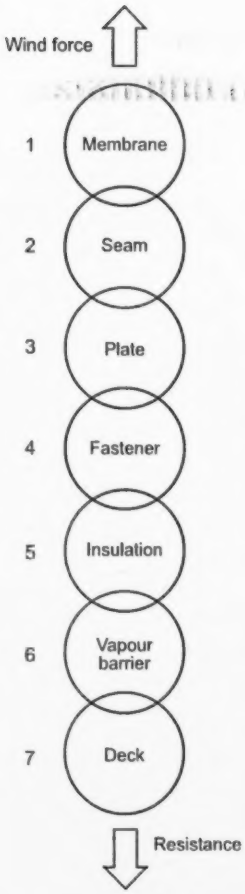
Led by IRC, SIGDERS—the Special Interest Group for Dynamic Evaluation of Roofing Systems—has been investigating the effects of wind on single-ply roofing (SPR) systems since 1994. Since its inception, the group's membership has grown steadily. The membership roster as of November 2001 includes:

Industry Associations
Canadian Roofing Contractors' Association
Canadian Sheet Steel Building Institute
Industrial Risk Insurers
National Roofing Contractors' Association
Roof Consultants Institute

Manufacturers
Atlas Roofing Corporation
Canadian General-Tower Ltd.
Carlisle SynTec Incorporated
GAF Materials Corporation
GenFlex Roofing Systems
Firestone Building Products Company
IKO Industries Ltd.
Johns Manville
Sarnafil
Soprema Canada
Stevens Roofing
Vicwest Steel

Building Owners
Canada Post Corporation
Department of National Defence
Public Works and Government Services Canada

Manufacturers will also gain information about the sustainability of roofing products in the North American climate from the latest upgrades to IRC's DRF. The addition of a thermal evaluation capacity makes the DRF the first facility in the world able to test roofing systems under simultaneous dynamic wind and temperature conditions. The temperatures available for conditioning range from the very low to the very high, in the range of -40C to +100C. This new capability will give unique insights into the relationship between temperature and wind resistance, and the resulting durability of roofing systems.



SIGDERS newly developed load cycle can identify the weakest link in a roofing system design.

Currently, Phase III of the SIGDERS project is developing a design manual for roofing systems with flexible membranes. This manual will ensure that the results of the consortium's work are widely available and can be applied by the roofing community. In addition, the consortium will be submitting the new test method to the CSA for evaluation as a possible national standard.

Specific questions can be directed to Dr. Bas Baskaran at (613) 990-3616, fax (613) 954-3733, or e-mail bas.baskaran@nrc.ca.

IRC evaluates corrosion inhibitors in reinforced concrete

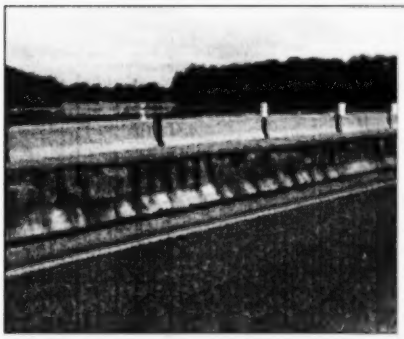
Corrosion is a major problem for most concrete structures, occurring in the steel bars used to reinforce the concrete. In fact, the expense incurred in North America as a result of corrosion-induced repair numbers in the billions of dollars, without even considering the environmental toll of repeated construction and repair. Corrosion inhibitors are one of the most cost-effective solutions to this problem, but little independent information is available on their effectiveness in actual use.

To remedy this problem, researchers in IRC's Urban Infrastructure Rehabilitation Program are working on two projects to study the long-term performance of corrosion inhibitors in field applications. The first project looks at the effectiveness of a variety of corrosion inhibiting systems used in the newly reconstructed barrier wall on the Vachon Bridge in Montreal, Quebec. The second looks at the effectiveness of one particular product used in the repair of the Laurier-Taché parking garage in Hull, Quebec.

Both projects demonstrate IRC's ability to instrument large structures to study corrosion in concrete, and to look at the problem from both the manufacturer's and the owner's perspective, as well as on a relatively large and small scale.

Vachon Bridge project

IRC researchers have just completed a five-year research project to study the performance of various products in inhibiting the corrosion of steel reinforcement used in the newly reconstructed concrete barrier wall on the Vachon Bridge. IRC, the Ministry of Transportation of Quebec and eight other partners (see sidebar) formed a consortium to address the difficulty that engineers and bridge owners face in selecting corrosion-inhibiting systems that are effective for reinforced concrete structures over the long term (see *Construction Innovation*, Fall 1998).



Vachon Bridge parapet wall shows significant corrosion prior to installation of corrosion inhibiting system.

Vachon Bridge project partners

Public sector:
Ministry of Transportation of Quebec
Regional Municipality of Peel
National Research Council Canada

Private sector:
Axim Concrete Technologies
Caruba Holdings
Euclid Admixture Canada
Israel Richler Trading
Master Builders Technologies
Sika Canada
W.R. Grace & Co.

IRC researchers selected 10 consecutive spans of the bridge for testing. Eight organic and inorganic corrosion-inhibiting systems were applied to the spans, including concrete admixtures, reinforcing steel coatings, and concrete surface coatings or sealants. The remaining two spans served as the control and epoxy-coated reinforcement testing sections.

To monitor the effectiveness of the corrosion inhibiting systems, the researchers equipped each span with temperature/humidity sensors, reference electrodes and strain gauges. They performed annual field corrosion surveys and tested concrete cores. They gathered information on the corrosion potential and currents in the reinforcing steel, as

Laurier-Taché Parking Garage project

Working with Public Works and Government Services Canada (PWGSC), IRC researchers are testing the effectiveness of a commercially available hydrophobic admixture in inhibiting corrosion in the concrete used to repair a parking garage. PWGSC is interested in finding out how well the concrete additive works on a small scale before going to the expense of using it in its structures across Canada.

The project will be split into two parts: laboratory and field trials. Laboratory testing will determine the physical properties of the modified concrete compared to the control material. Field trials in the garage will consist of six concrete slabs outfitted with embedded instrumentation, including thermocouples, relative humidity sensors, reference electrodes and strain gauges. The concrete in half of the slabs will contain the hydrophobic admixture. The other half will not contain the admixture and will function as a control group.

IRC researchers will monitor the rate of shrinkage and the corrosion of the reinforcing steel in the concrete for the next three years and hope to extend the project for a further three years.

Specific questions about the Laurier-Taché Parking Garage project can be directed to Dr. Lyndon Mitchell at (613) 998-0064, fax (613) 954-5984, or e-mail lyndon.mitchell@nrc.ca.

World construction industry to meet in Toronto in May 2004

"Building for the Future," the 2004 CIB World Building Congress, will be held in conjunction with the 5th International Conference on Indoor Air Quality, Ventilation and Energy Conservation in Buildings, and the 6th International Conference on Multipurpose High-rise Towers and Tall Buildings in May 2004.

The congress, which is being organized by the National Research Council of Canada, will provide a worldwide forum for meaningful exchange between researchers and practitioners seeking answers to critical issues that confront the construction industry every day, and will address topics such as

- building processes and techniques
- building envelope performance
- performance-based building and regulation systems
- sustainable construction
- building and process re-engineering
- tall buildings and high-rise towers
- indoor air quality and ventilation
- thermal comfort and energy conservation

This future-oriented forum will provide a unique opportunity for architects, consulting engineers, technologists and building owners/operators to learn about technology developments from around the world.

Mark your calendars!
May 2–7, 2004
The Westin Harbour Castle Hotel
Toronto, Ontario
Canada

For more information, visit our Web site at www.cib2004.ca.

Newsbrief

Information about crack and joint sealants now on the Web

Crack and joint sealants are used in the construction, maintenance and rehabilitation of pavements made of asphaltic or cementitious concrete. Sealing is one of the most common approaches used to limit the intrusion of water, salt and grit into joints and cracks, resulting in reduced deterioration and extended service life for pavements.

The performance of these sealants depends on the characteristics of the pavement and the method of installation, as well as on the type of sealant used, making it difficult to determine what the best product for a particular job really is. At present, there are dozens of publications on sealants and fillers for cracks and joints, but much of this literature is published by transportation agencies and departments in the form of internal reports; as a result, needed information is not always accessible to other interested parties.

To help improve access to information on this subject, IRC has developed two Web sites that make articles, reports and references more widely available.

- **http://www.nrc.ca/irc/uir/ur/guidelines.html**. This site provides a Canadian and urban perspective, highlighting the work of IRC's Urban Infrastructure Rehabilitation Program in increasing the durability of crack sealants and improving their installation. Documents can be downloaded or ordered from the Web site.
- **http://www.nrc.ca/irc/uir/ur/trb**, site of the U.S. Transportation Research Board's committee on sealants and fillers for joints and cracks, provides a North American perspective on the subject through its reviews of current specifications, and material and equipment suppliers. The site also provides useful links and references.

well as the concrete's compressive strength, chloride ion permeability and content, water absorption and water vapour permeability, concrete porosity, and freeze/thaw cycles.

In addition, the researchers used a unique reinforcing bar ladder system to study the effectiveness of the corrosion inhibitors. They embedded the ladders in a progressively thinner concrete cover, which made it possible to investigate the effectiveness of corrosion inhibiting systems over a relatively short time (five years).

A series of comparative laboratory experiments showed that one of the organic-based admixtures and one of the inorganic-based admixtures were very effective in reducing corrosion. In the field, however, the inorganic-based inhibitor system performed better than the other inhibitor systems.

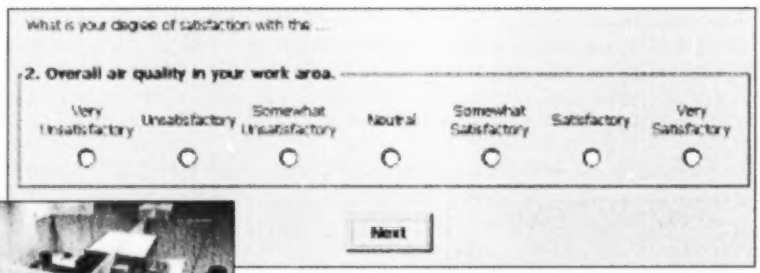
Field measurements of corrosion on the main spans show that the overall corrosion rates are detectable after five years in service but were still in the low category. These results indicate that more time is necessary to see significant corrosion activity and to evaluate the long-term effectiveness of the inhibitor systems. Negotiations to continue the project for another five years are underway.

Specific questions about the Vachon Bridge project can be directed to Dr. Shiyuan Qian at (613) 993-3814, fax (613) 952-8102, or e-mail shiyuan.qian@nrc.ca.

Environmental psychologists contribute to indoor environment research at IRC

It is estimated that most Canadians spend about 90% of their time indoors. The conditions they experience—including lighting, acoustics, indoor air quality, and the design of the space itself—can affect their comfort, mood, behaviour and health. To study these relationships between people and their environments, IRC's Indoor Environment Program includes expertise in environmental psychology.

An acoustics study being conducted at IRC's Indoor Environment Research Facility.



A sample question from a questionnaire used in a recent IRC study of how people respond to and experience their surroundings.

Environmental psychology is the scientific study of how people respond to and experience the physical world. Studies are conducted in both field and laboratory settings, using methods such as questionnaires, interviews, observations of patterns of human behaviour, and monitoring of task performance.

A common problem in indoor environment research is that it often focuses on either engineering *or* psychology issues. What makes the IRC program unique is that it draws together expertise from both fields, so that people and the physical environment—and the relationships between them—can be studied in detail and documented reliably. This enables property managers and building owners to make decisions about how to achieve occupant satisfaction *and* save money on building costs—energy and lighting being prime examples.

IRC's interdisciplinary approach has led to research that successfully combines the personal and the physical environments. In particular, extensive studies on the effects of office lighting on work performance and mood have been conducted, which have contributed to changes in lighting guidelines (see *Construction Innovation*, Fall 2001). In one such study, office workers who worked under energy-efficient lighting designs that controlled glare on computer screens did better in reading and writing tasks than people who worked under other lighting conditions. They also rated the tasks as being easier (see *Construction Innovation*, Winter 1998).

A current project on Cost-Effective Open-Plan Environments (COPE) takes this interdisciplinary approach, using laboratory and field studies to relate the physical environment in open-plan offices—including indoor air quality, lighting, acoustics, and office design—to measures of occupant satisfaction. The findings from the COPE project will be combined into a decision-making tool to help designers create offices that are satisfying to occupants, as well as being energy efficient and cost effective (see www.nrc.ca/irc/ie/cope).

One question of particular interest to designers, facilities managers and businesses is whether the indoor environment affects organizational productivity, which is defined as the ratio of "outputs" to "inputs." Inputs include salaries and benefits, recruitment costs, equipment, building operation and maintenance, and energy use. Outputs are influenced by factors such as individual work production, absenteeism, retention, and occupant satisfaction. Anecdotal evidence that the indoor environment affects organizational productivity is widely available, but solid research evidence is sparse. The COPE project addresses one part of the productivity equation by studying occupant satisfaction. In the future, the Indoor Environment Program plans to study organizational productivity in detail.

One of the most important implications of IRC's interdisciplinary approach is its potential for contributing to the well-being of Canadians. While current work with an environmental psychology component focuses on office environments, this approach can be applied just as easily to other settings where Canadians spend their time, such as homes, schools and hospitals. By including environmental psychology in its research perspective, IRC can provide a more complete picture of these indoor environments, thus better serving the needs of the construction industry and Canadians in general.

Specific questions can be directed to Dr. Kate Charles at (613) 991-0939, fax (613) 954-3733, or e-mail kate.charles@nrc.ca.

Green Roof Workshop held in Vancouver

In March, more than 100 professionals involved in the construction industry attended the Green Roof Workshop in Vancouver where they were encouraged to look at green roof technology from different perspectives. Green roofs, or rooftop gardens, offer opportunities for reducing energy costs and smog in cities by providing vegetation in growing mediums to offset the "heat islands" created by dark building materials and pavements. They can play a role in intercepting storm water runoff by replacing impermeable surfaces with vegetation.

Participants at the Green Roof Workshop in Vancouver tour the roof garden of the Vancouver Public Library.

The presentations provided a good mix of green roof information—from research, design and implementation to public policy.

Some highlights from the workshop included the following:

Discussion of the storm water challenge faced by Greater Vancouver

To address this issue, the Greater Vancouver Regional District has developed a continuous simulation water balance model to examine the hydrologic effectiveness of different storm water source controls, including the use of green roofs under different conditions, in reducing storm water runoff. The design and implementation of building retrofits that would be needed to establish green roofs were also discussed.

Research results from a recent project conducted at IRC's Field Roofing Facility in Ottawa

Dr. Karen Liu of the National Research Council's Institute for Research in Construction (IRC) presented the results of this study, comparing the thermal performance and storm water runoff of a green roof and a conventional modified bituminous roof. The results confirmed that the rooftop garden reduces the heat flow across the roofing system and lowers the energy required for space conditioning during the warmer months, as well as moderating the daily temperature fluctuations experienced by the roofing membrane. In addition, the green roof helped delay storm water runoff, and to reduce the runoff flow rate and volume. For more information about this project, see *Construction Innovation*, Winter 2002 at http://www.nrc.ca/irc/newsletter/v7no1/rooftop_e.html.

Dr. Liu also described a green roof monitoring project in Toronto being carried out by IRC researchers in conjunction with the City of Toronto, Environment Canada, Green Roofs for Healthy Cities, the federal government's Technology Early Action Measures program, and the Toronto Atmospheric Fund. For more information about this project, visit http://www.peck.ca/grhcc/overviewdemo.htm.

Presentation on the City of Portland's Ecoroof program

This is the first such program in North America to encourage the installation of green roofs through the introduction of new zoning by-laws and codes, financial incentives and storm water management credits. More information about this project can be found at http://www.cleanrivers-pdx.org/clean_rivers/ecoroof.htm.

Participants identified local research needs and obstacles to the implementation of green roofs in the Lower Mainland region, and focused their discussion on environmental and public health issues, technical and site design, and policy and economic considerations. The outcomes of these discussions will provide the framework for green roof implementation in the region in the future.

This event was sponsored by British Columbia Institute of Technology, Canada Mortgage and Housing Corporation (CMHC), Environment Canada, Greater Vancouver Regional District, Green Roofs for Healthy Cities, National Research Council Canada, Public Works and Government Services Canada, and Roofing Contractors Association of British Columbia.

Is Road Salt Being Banned?

In December 2001, Environment Canada declared road salt to be detrimental to the environment and recommended that it be designated as a toxic substance under the Canadian Environmental Protection Act (CEPA).

This recommendation came from a five-year study conducted by Environment Canada on the environmental implications of using salt as a de-icing agent for road maintenance in the winter and as a dust suppressant on gravel roads in the summer. The study found that while road salt posed no threat to human health, it did have a negative effect on soil, groundwater, rivers and streams, vegetation, fish and wildlife.

The findings from the study do not mean that road salt will be banned, but they do mean that its storage and use will be controlled and regulated. Over the next two years, Environment Canada will work with representatives from the provinces and territories, municipalities and roadway maintenance organizations to develop guidelines for its storage, spreading and disposal. The guidelines are to be implemented 18 months later.

Salt management measures being considered include:

- reducing losses at storage sites;
- improving application technologies and weather forecasting tools—both of which could lead to a reduced use of salt; and
- using alternative products when appropriate.

While it is true that the use of road salt has negative effects on the environment, as well as contributing to corrosion in roads and bridges, it is effective and inexpensive, and is the current de-icer of choice of most road authorities. The approach being taken by Environment Canada is expected to reduce these harmful effects without having to resort to a complete ban, and without compromising road and driver safety.

For further information, visit the Environment Canada Web site at www.ec.gc.ca.

Upcoming events

OCTOBER

1-25

BSI 2002 Seminar Series – "Sound Isolation and Fire Containment: Details that Work," presented by IRC in cities across Canada. Toronto, St. John's, Charlottetown, Halifax, Yellowknife, Edmonton and Winnipeg. http://www.nrc.ca/irc/bsi/2002/schedule.html

2-4

1st CSCE Atlantic Region Civil Engineering Conference & 12th Atlantic Region Hydrotechnical Conference. North River (near Charlottetown), PEI. http://www.umoncton.ca/chiassonp/Csce/ARC.htm

8-9

Construct Alberta. Calgary. www.constructalberta.com

NOVEMBER

1

Computer Aided Rehabilitation of Water Networks CASE-W. Dresden, Germany. http://www.tu-dresden.de/biwiss/stadtbau/stbwhome.htm

4-28

BSI 2002 Seminar Series – "Sound Isolation and Fire Containment: Details that Work," presented by IRC in cities across Canada. Vancouver, Calgary, Saskatoon, Toronto, Aylmer, Montreal and Sainte-Foy. http://www.nrc.ca/irc/bsi/2002/schedule.html

5

Expo-Contech. Montreal. www.contech.qc.ca

6-8

DMinUCE – London, 2002. The 3rd International Conference on Decision Making in Urban and Civil Engineering. http://www.serenade.org.uk

25-27

Infra2002. 8th Annual Urban Infrastructures Week. Montreal. http://www.ceriu.qc.ca/infra2002.htm

DECEMBER

4-6

Construct Canada 2002. Toronto. www.constructcanada.com

2003 JANUARY

12-15

82nd Annual Meeting of the Transportation Research Board. Washington, DC. http://www4.nationalacademies.org/trb/annual.nsf

29-30

Symposium on Durability of Building & Construction Sealants & Adhesives. Fort Lauderdale, FL. E-mail: Andreas.Wolf@dowcorning.com

FEBRUARY

3-4

Revaluing Construction–the International Agenda, Manchester, UK. http://www.revaluing-construction.com

27-28

9th Conference on Building Science & Technology. Vancouver. http://www.bcbec.com

MAY

8-10

CIB-CTBUH International Conference on Tall Buildings, Strategies for Performance in the Aftermath of the World Trade Center & The 2nd CIB Global Leaders Summit on Tall Buildings. Kuala Lumpur, Malaysia. www.cibklutm.com

This calendar does not include all events scheduled to take place during this time frame. For a more complete listing, see the Web version of "Upcoming events" at http://www.nrc.ca/irc/whatsnew/events.html

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